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18CV54

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
Basic Geotechnical Engineering

Time: 3 hrs.   Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define the following:
   (i) Water content   (ii) Void ratio
   (iii) Unit weight of soil   (iv) Density index   **(06 Marks)**

   b. Prove the relation $\gamma_{dry} = \dfrac{G r_w}{1+e}$ and Se = wG from basic principles. **(08 Marks)**

   c. A soil has a bulk unit weight of 26 kN/m³, G = 2.76 and water content 16%. Determine the dry unit weight, void ratio, porosity and degree of saturation. What is the unit weight if the soil gets fully saturated due to rain? **(06 Marks)**

OR

2 a. With the help of the phase diagram, define the terms bulk density, dry density, degree of saturation and specific gravity of soil solids. **(08 Marks)**

   b. Following are the results obtained from the tests conducted on two soils A and B. Classify them as per IS classification system. Explain the steps involved.

Soil	W_L (%)	W_P (%)	% retained on 75 μ sieve	% retained on 4.75 mm Sieve	C_u	C_c
A	110	50	40	Zero	-	-
B	-	-	92	05	0.7	0.2

(06 Marks)

   c. Explain the determination of specific gravity of soil solids by pycnometer method. **(06 Marks)**

Module-2

3 a. Explain different types of soil structures. **(08 Marks)**

   b. Discuss the factors affecting compaction in detail. **(06 Marks)**

   c. Determine the relative compaction of soil if the field density is 18.51 kN/m³; whose HDD is 22 kN/m³ and OMC is 13%. Comment on that. **(06 Marks)**

OR

4 a. Explain different types of clay minerals. **(08 Marks)**

   b. A proctor compaction test was conducted on a soil sample and the following observations were made:

W.C. (%)	8	11.5	14.5	17.5	19.5	21.5
Mass of the soil (kg)	1.70	1.90	2.0	1.98	1.95	1.92

If the volume of the mould is 950 C.C. and specific gravity of soil was 2.65, draw the:
   (i) Dry density v/s moisture content curve and get the maximum dry density and optimum moisture content.
   (ii) 100% saturation line.
   (iii) Also calculate the minimum void ratio and saturation at OMC. **(12 Marks)**

Module-3

5 a. List the factors affecting permeability in soils. Explain any four. **(08 Marks)**

   b. An earth dam is built on an impervious foundation with a horizontal filter under the downstream slope. The horizontal and vertical permeabilities of the soil material in the dam are 4×10^{-3} and 1×10^{-3} cm/s respectively. The full reservoir level is 15 m above downstream filter. A flow net, constructed for the transformed section of the dam, consists of 4 flow channels and 15 equipotential drops. Estimate the seepage loss per m length of the dam. **(08 Marks)**

   c. A stratum of fine sand is 2m thick. Under what head of water, flowing in an upward direction will the quick condition develop? Take $G = 2.68$ and $e = 0.6$. **(04 Marks)**

OR

6 a. Explain Casagrande's method of establishing the phreatic line of an earth dam with horizontal drainage filter on the downstream side. **(08 Marks)**

   b. Derive the expression for the determination of coefficient of permeability of the soil by falling head method. **(06 Marks)**

   c. Differentiate between: (i) Total stress   (ii) Pore water pressure   (iii) Effective stress **(06 Marks)**

Module-4

7 a. Derive the relation $\sigma_1 = \sigma_3 \tan^2 \alpha + 2c \tan \alpha$. **(08 Marks)**

   b. A shear box test conducted on a soil sample gives the following observations:

Normal load (N)	360	720	1080	1440
Shear load proving ring dial reading (divisions)	13	19	26	32

   If the shear box is 60 mm square and proving ring constant is 20 N per division. Find out the shear parameters (C & ϕ) of the soil in kN/m^2 and degrees respectively. **(12 Marks)**

OR

8 a. Write a note on Vane Shear test. **(08 Marks)**

   b. The following data relate to a triaxial compressive test performed on a soil samples.

Test No.	Confining Pressure (kN/m^2)	Deviatric Stress (kN/m^2)
1	80	175
2	150	240
3	210	300

   Determine the total stress parameters of the soil. **(12 Marks)**

Module-5

9 a. What is pre-consolidation pressure? How it is determined by Casagrande's method? **(08 Marks)**

   b. Explain pre-consolidated, normally consolidated and under consolidated soil. **(04 Marks)**

   c. A 30 cm thick sample of clay reached 30% consolidation in 15 minutes with drainage both at top and bottom. How long will it take the clay layer from which the sample was obtained to reach 50% consolidation? The clay layer has one-way drainage and was 6 m thick. **(08 Marks)**

OR

10 a. Explain the determination of coefficient of consolidation by square root of time fitting method. **(08 Marks)**

   b. A 3 m thick layer of clay was subjected to a loading of 0.7 kg/cm^2. It attained 50% consolidation after 1 year. The layer had double drainage. Determine:
   (i) Coefficient of consolidation   (ii) Settlement after one year if $k = 5$ mm/yr
   (iii) Time required for 90% consolidation **(12 Marks)**

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